UNIX PRINTING SYSTEM

DRAFT - CUPS Interface Design Description

CUPS-IDD-1.0

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1 Scope

1.1 Identification

This interface design description document provides detailed file formats, message formats, and program conventions for the Common UNIX Printing System ("CUPS") Version 1.0.

1.2 System Overview

The Common UNIX Printing System provides a portable printing layer for UNIX® operating systems. It has been developed by Easy Software Products to promote a standard printing solution for all UNIX vendors and users. CUPS provides the System V and Berkeley command-line interfaces.

CUPS uses the Internet Printing Protocol (IETF-IPP) as the basis for managing print jobs and queues. The Line Printer Daemon (LPD, RFC1179), Server Message Block (SMB), and AppSocket protocols are also supported with reduced functionality.

CUPS adds network printer browsing and PostScript Printer Description ("PPD")-based printing options to support real world applications under UNIX.

CUPS also includes a customized version of GNU GhostScript (currently based off GNU GhostScript 4.03) and an image file RIP that can be used to support non-PostScript printers.

1.3 Document Overview

This interface design description document is organized into the following sections:

- 1 - Scope
- 2 - References
- 3 - Internal Interfaces
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1 Scope

2 References

2.1 CUPS Documentation

The following CUPS documentation is referenced by this document:

- CUPS-CMP-1.0: CUPS Configuration Management Plan
- CUPS-IDD-1.0: CUPS System Interface Design Description
- CUPS-SAM-1.0.x: CUPS Software Administrators Manual
- CUPS-SDD-1.0: CUPS Software Design Description
- CUPS-SPM-1.0: CUPS Software Programming Manual
- CUPS-SSR-1.0: CUPS Software Security Report
- CUPS-STP-1.0: CUPS Software Test Plan
- CUPS-SUM-1.0.x: CUPS Software Users Manual
- CUPS-SVD-1.0.x: CUPS Software Version Description

2.2 Other Documents

The following non-CUPS documents are referenced by this document:

- IEEE 1387.4, System Administration: Printing (draft)
- IPP/1.0: Additional Optional Operations - Set 1
- IPP/1.0: Encoding and Transport
- IPP/1.0: Implementers Guide
- IPP/1.0: Model and Semantics
- RFC 1179, Line Printer Daemon Protocol

2 References

3 Internal Interfaces

3.1 Character Set Files

The character set files define a mapping between 8-bit characters and the Unicode character set. They are named using the ISO standard number defined for the character set. Each file consists of up to 256 lines of ASCII text. Each line consists of two hexadecimal numbers; the first number is the character number in the character set (0x00 to 0xff), and the second number is the Unicode character number (0x0000 to 0xffff).

3.2 Language Files

The language files define the default character set and a collection of text messages in that language. They are named by prefixing the string "cups_" to the front of the language specifier (e.g. "cups_en", "cups_fr", etc.) Each file consists of two or more lines of ASCII text.

The first line identifies the character set to be used for the messages. The currently recognized values are:

- us-ascii
- utf-8
- iso-8859-1
- iso-8859-2
- iso-8859-3
- iso-8859-4
- iso-8859-5
- iso-8859-6
- iso-8859-7
- iso-8859-8
- iso-8859-9
- iso-8859-14
- iso-8859-15

The second and succeeding lines define text messages. If the message text is preceded by a number, then the current message number is updated and the text after the number is used.

3.3 MIME Files

CUPS uses two MIME files in its standard configuration.

3.3.1 mime.types

The mime.types file defines the recognized file types and consists of 1 or more lines of ASCII text. Comment lines start with the pound ("#") character. The backslash ("\") character can be used at the end of a line to continue that line to the next.

Each non-blank line starts with a MIME type identifier ("super/type") as registered with the IANA. All text following the MIME type is treated as a series of type recognition rules:

```
mime-type := super "/" type { SP rule }*
super := { "a-z" | "A-Z" }*
type := { "a-z" | "A-Z" | "-" | "." | "0-9" }*
rule := { extension | match | operator | "(" rule ")" }*
extension := { "a-z" | "A-Z" | "0-9" }*
match := "match(" regexp ")" |
         "ascii(" offset "," length ")" |
         "printable(" offset "," length ")" |
         "string(" offset "," string ")" |
         "char(" offset "," value ")" |
         "short(" offset "," value ")" |
         "int(" offset "," value ")" |
         "locale(" string ")"
operator := "+" |         [ logical AND ]
            "," | SP      [ logical OR ]
            "!"           [ unary NOT ]
```

The `int` and `short` rules match look for integers in network byte order (a.k.a. big-endian) with the most-significant byte first.

3.3.2 mime.convs

The mime.types file defines the recognized file filters and consists of 1 or more lines of ASCII text. Comment lines start with the pound ("#") character.

Each non-blank line starts with two MIME type identifiers ("super/type") representing the source and destination types. Following the MIME types are a cost value (0 to 100) and the filter program to use. If the filter program is not specified using the full path then it must reside in the CUPS filter directory.

3.4 PostScript Printer Description Files

The PostScript Printer Description (PPD) file format is described in Adobe TechNote #5003: PostScript Printer Description File Format Specification Version 4.3.

3.4.1 CUPS Extensions to PPD Files

CUPS adds several new attributes that are described below.

3.4.1.1 cupsFilter

This string attribute provides a conversion rule of the form:

```
source/type cost program
```

The destination type is assumed to the printer's type. If a printer supports the source type directly the special filter program "-" may be specified.

3.4.1.2 cupsManualCopies

This boolean attribute notifies the RIP filters that the destination printer does not support copy generation in hardware. The default value is false.

3.4.1.3 cupsModelNumber

This integer attribute specifies a printer-specific model number. This number can be used by a filter program to adjust the output for a specific model of printer.

3.4.1.4 cupsProfile

This string attribute specifies a color profile of the form:

```
resolution/type density gamma m00 m01 m02 m10 m11 m12 m20 m21 m22
```

The *resolution* and *type* values may be "-" to act as a wildcard. Otherwise they must match one of the `Resolution` or `MediaType` attributes defined in the PPD file.

The *density* and *gamma* values define gamma and density adjustment function such that:

```
f(x) = density * xgamma
```

The *m00* through *m22* values define a 3x3 transformation matrix for the CMY color values. The density function is applied *after* the CMY transformation.

3.4.1.5 cupsVersion

This required attribute describes which version of the CUPS IDD was used for the PPD file extensions. Currently it must be the string "1.0".

3.5 Scheduler Configuration Files

The scheduler reads three configuration files that define the available printers, classes, and services:

> *classes.conf*
>
>> This file defines all of the printer classes known to the system.
>
> *cupsd.conf*
>
>> This file defines the files, directories, passwords, etc. used by the scheduler.
>
> *printers.conf*
>
>> This file defines all of the printers known to the system.

3.5.1 classes.conf

The classes.conf file consists of 1 or more lines of ASCII text. Comment lines start with the pound ("#") character.

Each non-blank line starts with the name of a configuration directive followed by its value. The following directives are understood:

Directive	Description
<Class name> </Class>	
<DefaultClass name> </Class>	
Info	
Location	
MoreInfo	
Printer	

3.5.2 cupsd.conf

The cupsd.conf file consists of 1 or more lines of ASCII text. Comment lines start with the pound ("#") character.

Each non-blank line starts with the name of a configuration directive followed by its value. The following directives are understood:

Directive	Default	Description
AccessLog		Specifies the location of the access log file (default "logs/access_log").
Allow		
AuthClass		
AuthType		
BrowseAddress		
BrowseInterval		
BrowsePort		
BrowseTimeout		
Browsing		
DefaultCharset		
DefaultLanguage		
Deny		
DocumentRoot		
ErrorLog		
Group		
HostNameLookups		
ImplicitClasses		
KeepAlive		
KeepAliveTimeout		
<Location path> </Location>		
LogLevel		
MaxClients		
MaxLogSize		
MaxRequestSize		
Order		
PageLog		
Port		
RIPCache		
ServerAdmin		
ServerName		

ServerRoot		
SystemGroup		
TempDir		
Timeout		
User		

3.5.3 printers.conf

The printers.conf file consists of 1 or more lines of ASCII text. Comment lines start with the pound ("#") character.

Each non-blank line starts with the name of a configuration directive followed by its value. The following directives are understood:

Directive	Description
<DefaultPrinter name> </Printer>	
DeviceURI	
Info	
Location	
MoreInfo	
<Printer name> </Printer>	
State	

4 External Interfaces

4.1 AppSocket Protocol

The AppSocket protocol is an 8-bit clean TCP/IP socket connection. The default IP service port is 9100.

4.2 CUPS Browsing Protocol

The CUPS Browsing Protocol is a UDP/IP-based broadcast service. By default this service operates on IP service port 631.

Each broadcast packet describes the state of a single printer or class and is an ASCII text string of up to 1450 bytes ending with a newline (0x0a). The string is formatted as follows:

```
type SP state SP uri NL
```

The *state* and *uri* values correspond to the IPP `printer-state` and `printer-uri-supported` attributes.

The *type* value is a hexadecimal number string representing capability/type bits:

Bit	Description
0	0 = printer 1 = class
1	0 = local 1 = remote (always 1)
2	1 = can print B
3	1 = can print color
4	1 = can duplex
5	1 = can staple
6	1 = can do fast copies
7	1 = can do fast collating
8	1 = can punch holes
9	1 = can cover
10	1 = can bind
11	1 = can sort

12	1 = can print up to 9x14 inches
13	1 = can print up to 18x24 inches
14	1 = can print up to 36x48 inches
15	1 = can print variable sizes

4.3 CUPS PostScript File

CUPS PostScript files are device-dependent Adobe PostScript program files. The PostScript language is described in the Adobe PostScript Language Reference Manual, Third Edition.

The MIME type for CUPS PostScript files is `application/vnd.cups-postscript`.

4.4 CUPS Raster File

CUPS raster files are device-dependent raster image files that contain a PostScript page device dictionary and device-dependent raster imagery for each page in the document. These files are used to transfer raster data from the PostScript and image file RIPs to device-dependent filters that convert the raster data to a printable format.

A raster file begins with a four byte synchronization word: 0x52615374 ("RaSt") for big-endian architectures and 0x74536152 ("tSaR") for little-endian architectures. The writer of the raster file will use the native word order, and the reader is responsible for detecting a reversed word order file and swapping bytes as needed. The CUPS Interface Library raster functions perform this function automatically.

Following the synchronization word are a series of raster pages. Each page starts with a page device dictionary header and is followed immediately by the raster data for that page.

Bytes	Description	Values
0-63	MediaClass	Nul-terminated ASCII string
64-127	MediaColor	Nul-terminated ASCII string
128-191	MediaType	Nul-terminated ASCII string
192-255	OutputType	Nul-terminated ASCII string
256-259	AdvanceDistance	0 to 2^{32} - 1 points
260-263	AdvanceMedia	0 = Never advance roll 1 = Advance roll after file 2 = Advance roll after job 3 = Advance roll after set 4 = Advance roll after page

264-267	Collate	0 = do not collate copies 1 = collate copies
268-271	CutMedia	0 = Never cut media 1 = Cut roll after file 2 = Cut roll after job 3 = Cut roll after set 4 = Cut roll after page
272-275	Duplex	0 = Print single-sided 1 = Print double-sided
276-283	HWResolution	Horizontal and vertical resolution in dots-per-inch.
284-299	ImagingBoundingBox	Four integers giving the left, bottom, right, and top positions of the page bounding box in points
300-303	InsertSheet	0 = Do not insert separator sheets 1 = Insert separator sheets
304-307	Jog	0 = Do no jog pages 1 = Jog pages after file 2 = Jog pages after job 3 = Jog pages after set
308-311	LeadingEdge	0 = Top edge is first 1 = Right edge is first 2 = Bottom edge is first 3 = Left edge is first
312-319	Margins	Left and bottom origin of image in points
320-323	ManualFeed	0 = Do not manually feed media 1 = Manually feed media
324-327	MediaPosition	Input slot position from 0 to N
328-331	MediaWeight	Media weight in grams per meter squared
332-335	MirrorPrint	0 = Do not mirror prints 1 = Mirror prints
336-339	NegativePrint	0 = Do not invert prints 1 = Invert prints
340-343	NumCopies	1 to 2^{32} - 1
344-347	Orientation	0 = Do not rotate page 1 = Rotate page counter-clockwise 2 = Turn page upside down 3 = Rotate page clockwise
348-351	OutputFaceUp	0 = Output face down 1 = Output face up
352-359	PageSize	Width and length in points
360-363	Separations	0 = Print composite image 1 = Print color separations

4.4 CUPS Raster File

364-367	TraySwitch	0 = Do not change trays if selected tray is empty 1 = Change trays if selected tray is empty
368-371	Tumble	0 = Do not rotate even pages when duplexing 1 = Rotate even pages when duplexing
372-375	cupsWidth	Width of page image in pixels
376-379	cupsHeight	Height of page image in pixels
380-383	cupsMediaType	Driver-specific 0 to $2^{32} - 1$
384-387	cupsBitsPerColor	1, 2, 4, 8 bits
388-391	cupsBitsPerPixel	1 to 32 bits
392-395	cupsBytesPerLine	1 to $2^{32} - 1$ bytes
396-399	cupsColorOrder	0 = chunky pixels (CMYK CMYK CMYK) 1 = banded pixels (CCC MMM YYY KKK) 2 = planar pixels (CCC... MMM... YYY... KKK...)
400-403	cupsColorSpace	0 = white 1 = RGB 2 = RGBA 3 = black 4 = CMY 5 = YMC 6 = CMYK 7 = YMCK 8 = KCMY 9 = KCMYcm
404-407	cupsCompression	Driver-specific 0 to $2^{32} - 1$
408-411	cupsRowCount	Driver-specific 0 to $2^{32} - 1$
412-415	cupsRowFeed	Driver-specific 0 to $2^{32} - 1$
416-419	cupsRowStep	Driver-specific 0 to $2^{32} - 1$

The MIME type for CUPS Raster files is `application/vnd.cups-raster`.

4.5 CUPS Raw Files

Raw files are printer-dependent print files that are in a format suitable to the destination printer (e.g. HP-PCL, HP-RTL, etc.) The MIME type for CUPS Raw files is `application/vnd.cups-raw`.

4.6 File Transfer Protocol

The File Transfer Protocol (FTP) is described by [RFC 959: File Transfer Protocol](#).

4.7 Internet Printing Protocol

The Internet Printing Protocol is described by the following RFCs:

- [RFC 2565: Internet Printing Protocol/1.0: Encoding and Transport](#)
- [RFC 2566: Internet Printing Protocol/1.0: Model and Semantics](#)
- [RFC 2567: Design Goals for an Internet Printing Protocol](#)
- [RFC 2568: Rationale for the Structure of the Model and Protocol for the Internet Printing Protocol](#)
- [RFC 2569: Mapping between LPD and IPP Protocols](#)

CUPS defines the following extension operations to IPP.

4.7.1 Get Default Destination (CUPS_GET_DEFAULT = 0x4001)

The get default destination operation returns the printer attributes for the system default printer or class. The only required attributes are `attributes-charset` and `attributes-natural-language`.

Get default destination will only return `ipp-ok`.

4.7.2 Get Printers (CUPS_GET_PRINTERS = 0x4002)

The get printers operation returns the printer attributes for all printers known to the system. The only required attributes are `attributes-charset` and `attributes-natural-language`.

Get printers will only return `ipp-ok`.

4.7.3 Add Printer (CUPS_ADD_PRINTER = 0x4003)

The add printer operation adds or replaces the specified printer. The `attributes-charset`, `attributes-natural-language` and `printer-uri` attributes are required.

The `printer-location`, `printer-info`, `printer-more-info`, and `device-uri` attributes are required when initially adding a printer and optional when modifying a printer.

A PPD file or System V interface script may follow the IPP request body. If a valid interface script or PPD file is not provided then the printer is treated as a generic PostScript device.

Add printer will return `ipp-ok`, `ipp-not-authorized`, `ipp-bad-request`, or `ipp-attributes`.

4.7.4 Delete Printer (CUPS_DELETE_PRINTER = 0x4004)

The delete printer operation removes the specified printer. The only required attributes are `attributes-charset`, `attributes-natural-language`, and `printer-uri`.

Delete printer will return `ipp-ok`, `ipp-not-found`, or `ipp-not-authorized`.

4.7.5 Get Classes (CUPS_GET_CLASSES = 0x4005)

The get classes operation returns the printer attributes for all classes known to the system. The only required attributes are `attributes-charset` and `attributes-natural-language`.

Get classes will only return `ipp-ok`.

4.7.6 Add Class (CUPS_ADD_CLASS = 0x4006)

The add class operation adds or replaces the specified class. The `attributes-charset`, `attributes-natural-language`, and `printer-uri` attributes are required.

The `printer-location`, `printer-info`, `printer-more-info`, and `member-uris` attributes are required when initially adding a printer and optional when modifying a printer.

Add class will return `ipp-ok`, `ipp-not-authorized`, `ipp-bad-request`, or `ipp-attributes`.

4.7.7 Delete Class (CUPS_DELETE_CLASS = 0x4007)

The delete class operation removes the specified class. The only required attributes are `attributes-charset`, `attributes-natural-language`, and `printer-uri`.

Delete class will return `ipp-ok`, `ipp-not-found`, or `ipp-not-authorized`.

4.7.8 Accept Jobs (CUPS_ACCEPT_JOBS = 0x4008)

The accept jobs operation allows jobs to be accepted by the specified destination. The only required attributes are `attributes-charset`, `attributes-natural-language`, and `printer-uri`.

Accept jobs will return `ipp-ok`, `ipp-not-found`, or `ipp-not-authorized`.

4.7.9 Reject Jobs (CUPS_REJECT_JOBS = 0x4009)

The reject jobs operation prevents jobs from being accepted by the specified destination. The only required attributes are `attributes-charset`, `attributes-natural-language`, and `printer-uri`.

Reject jobs will return `ipp-ok`, `ipp-not-found`, or `ipp-not-authorized`.

4.7.10 Set Default Destination (CUPS_SET_DEFAULT = 0x400A)

The set default destination operation returns the printer attributes for the system default printer or class. The only required attributes are `attributes-charset`, `attributes-natural-language`, and `printer-uri`.

Set default destination will return `ipp-ok`, `ipp-not-authorized`, `ipp-bad-request`, or `ipp-not-found`.

4.8 Line Printer Daemon Protocol

The Line Printer Daemon (LPD) protocol is described by [RFC 1179: Line Printer Daemon Protocol](#).

4.9 Server Message Block Protocol

The Server Message Block (SMB) and related Common Internet File System (CIFS) protocols are described at http://anu.samba.org/cifs.

4.10 Trivial File Transfer Protocol

The Trivial File Transfer Protocol (TFTP) is described by [RFC 1350: The TFTP Protocol (Revision 2)](#).

5 5 - Directories

/usr/bin

> The `cancel`, `lp`, `lpq`, `lpr`, `lprm`, and `lpstat` commands reside here.

/usr/lib

> The `accept`, `disable`, `enable`, `lpadmin`, and `reject` commands reside here.

/usr/sbin

> The `lpc` and `cupsd` commands resize here.

/usr/share/cups

> This is the root directory of the CUPS static data.

/usr/share/cups/data

> The character set and filter data files reside here.

/usr/share/cups/fonts

> The `pstoraster` font files reside here.

/usr/share/cups/model

> The sample PPD files reside here.

/usr/share/cups/pstoraster

> The `pstoraster` data files reside here.

/var/cups

> This is the root directory of the CUPS scheduler.

/var/cups/backend

> The backend filters reside here.

/var/cups/cgi-bin

> The CGI programs reside here.

/var/cups/conf

> The scheduler configuration and MIME files reside here.

/var/cups/doc

> The scheduler documentation files reside here.

/var/cups/filter

> The file filters reside here.

/var/cups/interfaces

> System V interface scripts reside here.

/var/cups/logs

> The `access_log`, `error_log`, and `page_log` files reside here.

/var/cups/ppd

> This directory contains PPD files for each printer.

/var/cups/requests

> This directory contains pending print job files.

A Glossary

A.1 Terms

C

A computer language.

parallel

Sending or receiving data more than 1 bit at a time.

pipe

A one-way communications channel between two programs.

serial

Sending or receiving data 1 bit at a time.

socket

A two-way network communications channel.

A.2 Acronyms

ASCII

American Standard Code for Information Interchange

CUPS

Common UNIX Printing System

ESC/P

EPSON Standard Code for Printers

FTP

File Transfer Protocol

HP-GL

Hewlett-Packard Graphics Language

HP-PCL

       Hewlett-Packard Printer Control Language

HP-PJL

       Hewlett-Packard Printer Job Language

IETF

       Internet Engineering Task Force

IPP

       Internet Printing Protocol

ISO

       International Standards Organization

LPD

       Line Printer Daemon

MIME

       Multimedia Internet Mail Exchange

PCL

       Page Control Language

PPD

       PostScript Printer Description

SMB

       Server Message Block

TFTP

       Trivial File Transfer Protocol